

CLAIMS

What is claimed is:

1. A process for manufacturing one-piece foliated leads from wire, the foliated lead comprising a foil bookended by a first lead wire and a second lead wire, the process comprising
5 the steps of:

providing two opposed hammers, each having a working face centered on an axis;
aligning the working faces of the two hammers to be centered on a common axis;
positioning a portion of wire between the working faces and orthogonally crossing
through the common axis;

10 foliating the wire by hammering the wire between the working faces with a predetermined plurality of blows wherein the motion of hammering is along the common axis; and
increasing the magnitude of hammering energy for each succeeding blow.

2. The process of claim 1, wherein:

the magnitude of hammering energy is increased at least linearly for each succeeding
15 blow.

3. The process of claim 1, further comprising the steps of:

tensioning the portion of wire during the foliating step; and

keeping the hammers centered on a foliated portion of the wire during the foliating step.

4. The process of claim 1, further comprising the steps of:

20 supplying a continuous length of wire;

conducting the process in sequential cycles, each cycle comprising a step of advancing the wire, followed by a step of processing portions of the wire simultaneously in each of a plurality of stages of the process;

advancing the wire by a step distance selected to produce a uniform predetermined foil
25 spacing along the continuous length of wire that is a foliated wire after a hammering stage being the process of claim 1; and

providing a cutting stage for cutting the foliated leads off an end of the foliated wire.

5. The process of claim 4, further comprising the step of:

after the hammering stage, providing a straightening stage comprising the step of:

30 pulling longitudinally on the first lead wire and the second lead wire in order to tension the foil therebetween such that lateral edges of the foil are curled around a longitudinal line.

6. The process of claim 5, further comprising the step of:
heating the foil during the straightening stage.

7. The process of claim 6, further comprising the step of:
using an oxidizing heat source such that etching of the foil is included in the heating step.

5 8. The process of claim 5, further comprising the step of:
between the straightening stage and the cutting stage, providing a foil etching stage for
etching the foil.

9. The process of claim 4, further comprising the step of:
before the cutting stage, providing a foil etching stage for etching the foil.

10 10. The process of claim 9, wherein the foil etching stage further comprises the steps of:
firstly passing the foliated wire through electroetching fluid contained in a first etching
bath that also contains a first electrode connected to a first pole of an AC power supply; and
secondly passing the foliated wire through electroetching fluid contained in a second
etching bath that also contains a second electrode connected to a second pole, opposite to the first
15 pole, of the AC power supply.

11. The process of claim 10, further comprising the step of:
passing the foliated wire through the first etching bath and through the second etching
bath by passing through a plurality of seals below a fluid level of the electroetching fluid such
that each one of the plurality of seals allows passage of the foliated wire while limiting fluid loss
20 leaking out.

12. The process of claim 4, wherein the cutting stage further comprises the step of:
forming cut ends each having at least one spur protruding laterally beyond a perimeter of
the wire.

13. The process of claim 12, wherein the cutting stage further comprises the step of:
25 cutting the wire with a blunt cutting blade.

14. The process of claim 12, wherein the cutting stage further comprises the step of:
forming at least every other cut end at an angle to the wire of about 45 degrees to about
75 degrees; such that a single spur protrudes laterally beyond the perimeter of the wire.

30 15. A lead processing line for manufacturing one-piece foliated leads from wire, the
foliated lead comprising a foil bookended by a first lead wire and a second lead wire, the lead

processing line comprising a hammering stage that comprises:

two opposed hammers, each having a working face on a frustum wherein the working face has a slightly convex surface centered on an axis;

alignment of the working faces of the two hammers to be centered on a common axis

5 with opposed working faces;

positioning of a portion of wire between the working faces and orthogonally crossing through the common axis; and

a hammering drive that foliates the wire by hammering the wire between the working faces with a predetermined plurality of blows along the common axis, wherein the magnitude of
10 hammering energy increases for each succeeding blow.

16. The lead processing line of claim 15, further comprising:

tensioning devices that tension the portion of wire during the hammering in the hammering stage, and that keep a foliated portion of the wire centered on the hammers during the hammering.

15 17. The lead processing line of claim 16, further comprising:

an arrangement of processing stages comprising:

a wire supply that supplies a continuous length of the wire to the hammering stage;

a wire advancing device that advances the wire by a step distance selected to produce a uniform predetermined foil spacing along the continuous length of wire that is a foliated wire

20 after the hammering stage; and

a cutting stage comprising a cutter for cutting the foliated leads off an end of the foliated wire.

18. The lead processing line of claim 17, further comprising:

after the hammering stage, a straightening stage comprising a tensioning device for

25 tensioning the foil such that lateral edges of the foil are curled around a longitudinal line.

19. The lead processing line of claim 18, further comprising:

heat supplied to the foil during the straightening stage.

20. The lead processing line of claim 19, further comprising:

an oxidizer of the foil during the straightening stage.

30 21. The lead processing line of claim 18, further comprising:

a foil etching stage between the straightening stage and the cutting stage.

22. The lead processing line of claim 17, further comprising:

a foil etching stage before the cutting stage.

23. The lead processing line of claim 22, wherein the foil etching stage comprises a two-bath AC electrochemical etching process comprising:

5 a first etching bath containing electroetching fluid and a first electrode connected to a first pole of an AC power supply;

a second etching bath containing electroetching fluid and a second electrode connected to a second pole, opposite to the first pole, of the AC power supply; and

10 a conductor of electrical current between the electroetching fluid in the first etching bath and the electroetching fluid in the second etching bath, the conductor being the foliated wire.

24. The lead processing line of claim 23, wherein the foil etching stage further comprises:

15 a plurality of grommet seals mounted within holes below a fluid level of the electroetching fluid, the holes being located in opposed ends of the first etching bath and in opposed ends of the second etching bath, such that the grommet seals allow passage of the foliated wire through the grommet seal while limiting fluid loss leaking out.

25. The lead processing line of claim 17, wherein the cutting stage further comprises:

opposed cutting blade edges aligned in a central plane of the cutter, each blade edge being defined at a vertex of blade sides that form a blade angle in the range of about 60 degrees to about 120 degrees wherein the blade angle is approximately halved by the central plane;

20 configuration of the cutter such that the opposed cutting blade edges move together within the central plane; and

positioning of the cutting blade edges at a predetermined cut angle relative to the wire.

26. The lead processing line of claim 16, wherein the cutting stage further comprises:

25 opposed cutting blades, at least one of which comprises a cutting blade edge defined at a vertex of blade sides wherein the cutting blade edge is blunt; and

positioning of the cutting blade edges at a predetermined cut angle relative to the wire.

27. A one-piece foliated lead for sealing in vitreous material, the foliated lead comprising:

a length of wire formed into a foil bookended by a first lead wire and a second lead wire;

30 and

lateral edges of the foil wherein the lateral edges all curl around a longitudinal line and all

curl toward one face of the foil.

28. The one-piece foliated lead of claim 27, wherein:

the foil is formed by a hammering process followed by a stretch-straightening process.